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SEALABLE FASTENER WITH SEALANT DELIVERY PASSAGEWAY TO CIRCUMFERENTIAL SEALANT CHANNEL AND METHOD

Filing History

This application is a based in part upon the disclosure contained within disclosure document number 495,287 filed on June 13, 2001, and a continuation-in-part of application serial number 09/931,697, filed on August 15, 2001, and a continuation-in-part of application serial number 09/982,400 filed on October 18, 2001, and a continuation-in-part of application serial number 10/084,288 filed on February 27, 2002.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates generally to the field of fasteners, particularly in the marine and construction industries, including screws, such as those used to construct boat hulls, bolts, such as concrete anchor bolts, and including rivets, nails and pins. More specifically the present invention relates to a sealable fastener including a fastener head integrally joined to a fastener shank having shank first and second ends with shank first and second end walls, a longitudinal shank side wall and a continuous, fully circumferential channel recessed into the shank side wall adjacent to the fastener head, and including a sealant delivery passageway having a passageway entry port in the fastener head and extending both longitudinally and laterally to a passageway exit port opening into the circumferential channel. The

sealant delivery passageway may be a bore in the shank extending substantially coaxially with or substantially parallel to the shank longitudinal axis, or may be a combination of fastener head bore through the fastener head and a groove in the shank side wall extending substantially parallel to the shank longitudinal axis. When the fastener is to be used, the fastener shank is inserted into a fastener bore in a receiving structure such as a boat hull or a nut, and then a flowable sealant is injected into the entry port so that the sealant flows through the sealant delivery passageway and exits through the exit port and flows into and around the circumferential channel, creating a circumferential seal between the fastener shank and the receiving structure so that water or other liquid cannot flow around the fastener shank and through the receiving structure. Several circumferential channels interconnected by segments of the sealant delivery passageway may be provided on a fastener for further enhanced sealing. This sealable fastener is intended primarily for the marine and construction industries, but many other home and industrial applications are contemplated.

2. Description of the Prior Art:

There have long been fasteners having fastener shanks for extending through and interconnecting multiple discrete fastener receiving structures. These prior fasteners have included bolts, screws, rivets, pins and nails. A problem with these prior fasteners has been that no truly effective means has been provided

for creating a seal between the shank of the fastener and the surrounding receiving structure to reliably prevent liquid from flowing along the shank from one side of the receiving structure to the other. This problem is particularly noteworthy in the marine industry and is probably the most common cause of leakage in boat hulls, and is also noteworthy in the construction industry in leakage at roof fasteners and in concrete anchor bolts and in industry in general such as in flange bolts at high pressure pipe joints and on vacuum vessels.

Jansen, et al., U.S. Patent Number 2,550,357, issued on April 24, 1951, discloses a sealable fastening device. Jansen, et al. teaches a screw or bolt having a fastener head and a shank extending downwardly from the fastener head, the fastener head having a fastener head lower face and a circumferential channel in the fastener head lower face and a sealant delivery bore extending from through the fastener head to the circumferential channel. The Jansen, et al. fastener head lower face is either planar to fit flat against the surface of a receiving structure surrounding a fastener receiving bore or is beveled to fit into the upper portion of a countersunk bore. A problem with Jansen, et al. is that impact against the receiving structure surface adjacent to the fastener head may cause a dent or depression in the receiving structure extending underneath the head and thereby break the seal between the sealant in the circumferential channel in the fastener head lower face and the depressed receiving structure surface beneath the fastener head lower face.

It is thus an object of the present invention to provide a fastener which includes a shank for passing through a receiving structure including means for reliably delivering flowable sealant circumferentially around the shank, preferably into a circumferential channel, creating a circumferential seal between the shank and the receiving structure, thereby preventing flow of liquid along the shank and through the receiving structure.

It is another object of the present invention to provide such a fastener which delivers flowable sealant against a receiving structure opening interior surface which is substantially parallel to the fastener longitudinal axis.

It is yet another object of the present invention to provide such a fastener which may take any conventional form, such as a bolt, screw, rivet, pin or nail.

It is still another object of the present invention to provide such a fastener which is inserted into a receiving structure in the same way and with the same tool or tools used to insert an otherwise similar fastener, and through which a flowable sealant can be rapidly, easily and reliably delivered.

It is finally an object of the present invention to provide such a fastener which is relatively inexpensive to manufacture and to install in a receiving structure.

SUMMARY OF THE INVENTION

The present invention accomplishes the above-stated objectives, as well as others, as may be determined by a fair reading and interpretation of the entire specification.

A sealable fastener is provided for insertion into a fastener opening in a receiving structure, the sealable fastener including a fastener shank including a shank longitudinal axis and a shank first end terminating at and integrally joined to a fastener head having a fastener first end wall and a shank second end terminating at a fastener second end wall, a shank side wall between the fastener head and the fastener second end wall and having a circumferential channel in the shank side wall extending to the fastener head and opening radially outward from the shank longitudinal axis, the shank side wall additionally having a fastener thread between the circumferential channel and the fastener second end wall; and a sealant delivery passageway having a passageway entry port in the fastener head and a passageway exit port opening into the circumferential channel and extending from the passageway entry port to the passageway exit port; so that a flowable sealant is injectable into the delivery passageway entry port, so that the sealant flows through the sealant delivery passageway and exits through the delivery passageway exit port and flows into and around the circumferential channel, creating a circumferential seal between the fastener shank and the fastener opening in the receiving structure.

The shank side wall preferably includes several of the circumferential channels. The fastener preferably is one of a bolt and a screw.

A sealable fastener is further provided for insertion into a fastener opening in a receiving structure, the sealable fasten r including a fastener shank including a shank longitudinal axis and a shank first end terminating at and integrally joined to a fastener head having a fastener first end wall and a shank second end terminating at a fastener second end wall, a shank side wall between the fastener head and the fastener second end wall, the shank side wall including a first circumferential channel in th shank side wall extending to the fastener head and opening radially outward from the shank longitudinal axis, a fastener thread between the circumferential channel and the fastener second end wall, and a second circumferential channel in the shank side wall between the first circumferential channel and the fastener second end wall; and a sealant delivery passageway having a first passageway entry port in the fastener head and having a first passageway exit port opening into the first circumferential channel and a second passageway exit port opening into the second circumferential channel and extending from the first passageway entry port through the fastener head to the first passageway exit port and to the second passageway exit port; so that flowable sealant injected into the passageway entry port flows through the sealant delivery passageway, out of the first passageway exit port and into and around th first circumferential channel and out of the second

passageway exit port and into and around the second circumferential channel, creating circumferential seals between the fastener shank and the fastener opening in the receiving structure.

A sealable fastener and fastener receiving structure are provided, including a fastener receiving structure having a fastener opening with a fastener opening longitudinal axis and a fastener opening interior surface substantially parallel with the fastener opening longitudinal axis; a sealable fastener including a fastener shank extending inside the fastener opening and having a shank longitudinal axis substantially parallel with the fastener opening longitudinal axis and a shank first end terminating at and integrally joined to a fastener head having a fastener first end wall and a shank second end terminating at a fastener second end wall, a shank side wall substantially parallel with the fastener opening longitudinal axis and extending between the fastener head and the fastener second end wall and having a circumferential channel in the shank side wall extending to the fastener head and opening radially outward from the shank longitudinal axis, the shank side wall additionally having a fastener thread between the circumferential channel and the fastener second end wall; and a sealant delivery passageway having a passageway entry port in the fastener head and a passageway exit port opening into the circumferential channel and extending from the passageway entry port to the passageway exit port; so that a flowable sealant is injectable into the delivery passageway entry port, so that the sealant flows through the sealant delivery passageway and exits

through the delivery passageway exit port and flows into and around the circumferential channel and into contact with fastener opening interior surface, creating a circumferential seal between the fastener shank and the fastener opening interior surface.

A method of securing a sealable fastener into a fastener receiving structure is provided including a fastener opening with a fastener opening longitudinal axis and a fastener opening interior surface substantially parallel with the fastener opening longitudinal axis; the sealable fastener including a fastener shank having a shank longitudinal axis substantially parallel with th fastener opening longitudinal axis and a shank first end terminating at and integrally joined to a fastener head having a fastener first end wall and a shank second end terminating at a fastener second end wall, a shank side wall substantially parallel with the fastener opening longitudinal axis and extending between the fastener head and the fastener second end wall and having a circumferential channel in the shank side wall extending to the fastener head and opening radially outward from the shank longitudinal axis, the shank side wall additionally having a fastener thread between the circumferential channel and the fastener second end wall; and a sealant delivery passageway having a passageway entry port in the fastener head and a passageway exit port opening into the circumferential channel and extending from the passageway entry port to the passageway exit port; the method including the steps of: inserting the shank second end into the fastener opening; rotating the fastener so that the fastener shank

advances into the fastener opening until the fastener head abuts the fastener receiving structure; injecting a flowable sealant into the delivery passageway entry port; and driving the sealant through the sealant delivery passageway and through the delivery passageway exit port and into and around the circumferential channel and into circumferential sealing contact with the fastener opening interior surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, advantages, and features of the invention will become apparent to those skilled in the art from the following discussion taken in conjunction with the following drawings, in which:

FIGURE 1 is a side view of a fastener according to the invention, in the form of either a boat hull screw or a concrete anchor bolt and having an axial sealant delivery passageway with longitudinal and radial passageway segments and having a single circumferential channel adjacent to the fastener head.

FIGURE 2 is a cross-sectional side view of the fastener of FIGURE 1.

FIGURE 3 is a side view of a fastener as in FIGURE 1, with a second circumferential channel added at the fastener shank middle region.

FIGURE 4 is a cross-sectional side view of the fastener of FIGURE 3.

FIGURE 5 is a side view of a fastener according to the invention, in the form of a boat hull screw and having a sealant delivery passageway extending through the fastener head parallel to and spaced laterally from the shank longitudinal axis and having a single circumferential channel adjacent to the fastener head.

FIGURE 6 is a cross-sectional side view of the fastener of FIGURE 5.

FIGURE 6a is a cross-sectional side view of the embodiment of the inventive fastener having a single channel immediately adjacent to the fastener head fitted through fastener openings or bores in two abutting receiving structures, showing flowable sealant being injected by the nozzle of an adhesive gun through the delivery passageway and circumferentially filling the channel so that the sealant makes circumferential sealing contact with the fastener opening interior surface.

FIGURE 7 is a side view of a fastener as in FIGURE 5, with a sealant delivery passageway segment in the form of a longitudinal groove in the shank side wall leading to a second circumferential channel added at the fastener shank middle region. In this FIGURE the fastener is oriented so that the longitudinal groove is directly toward the viewer, and the first sealant delivery passageway passing through the fastener head is shown in broken lines.

FIGURE 7a is another side view of the fastener of FIGURE 7, with the fastener oriented so that the longitudinal groove opens to the right in the FIGURE.

FIGURE 8 is a cross-sectional side view of the fastener of FIGURE 7a.

FIGURE 9 is a side view of a fastener substantially as in FIGURE 5, except that the fastener head is a hex head and the fastener has a sealant delivery passageway extending through the fastener head from an entry port at the center of the fastener head and angling radially outwardly to an exit port opening into a single circumferential channel adjacent to the fastener head.

FIGURE 10 is a cross-sectional side view of the fastener of FIGURE 9.

FIGURE 11 is a perspective view of a broken away fastener head having the sealant delivery passageway or first sealant delivery passageway segment in the form of a notch in the fastener head, opening into the circumferential channel or into the first circumferential channel.

FIGURE 12 is a side view of a fastener having the sealant channel and delivery passageway of the present invention.

FIGURE 13 is a cross-sectional side view of the fastener of FIGURE 12, revealing the sealant delivery passageway.

FIGURE 14 is a side view as in FIGURE 12 of a double channel embodiment of the fastener.

FIGURE 15 is a cross-sectional side view of the fastener of FIGURE 14, revealing the two sealant delivery passageways.

FIGURE 16 is a side view as in FIGURE 12 of a triple channel embodiment of the fastener.

FIGURE 17 is a cross-sectional side view of the fastener of FIGURE 16, revealing the three sealant delivery passageways.

FIGURE 18 is a cross-sectional side view of the open ended channel, extending from the passageway exit port to the fastener head.

FIGURE 19 is a cross-sectional side view of the triple channel embodiment of the inventive fastener fit through bores in two abutting receiving structures, showing flowable sealant being injected by the nozzle of an adhesive gun and circumferentially filling the three channels to create a triple seal.

FIGURE 20 is a cross-sectional side view of the open ended channel embodiment of the inventive fastener fit through bores in two abutting receiving structures, showing flowable sealant being injected by the nozzle of an adhesive gun and circumferentially filling the open ended channel to create a seal.

FIGURE 21 is a lateral cross-section of the fastener shank across a circumferential channel showing the axial passageway segment and a single radial passageway segment. FIGURE 21a is a lateral cross-section of the fastener shank across a circumferential channel showing the axial passageway segment and a two radial passageway segments. FIGURE 21b is a lateral cross-section as in FIGURE 21a showing the axial passageway segment, but a three radial passageway segments.

FIGURE 22 is a side view of a rivet equipped with the sealant channel and delivery passageway of the present invention, shown in broken lines.

FIGURE 23 is a transparent, perspective view of a bolt equipped with three sealant delivery passageways and showing the preferred seal confirmation passageway opening out of the most distal, third sealant delivery passageway opposite its passageway radial segment and extending generally axially within the shank to open out of the head of the bolt. Sealant pumped into the third sealant delivery passageway flows into the seal confirmation passageway until the sealant begins to escape through the delivery passageway exit port in the shank first end to indicate that all circumferential channels are filled with sealant and all three form a circumferential seal around the bolt shank.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure.

Reference is now made to the drawings, wherein like characteristics and features of the present invention shown in the various FIGURES are designated by the same reference numerals.

First Preferred Embodiment

Referring to FIGURES 1-23, a sealable fastener 10 is disclosed including a fastener shank 20 having a shank first end 22 terminating at a fastener head 60, the fastener head 60 having a fastener first end wall 24, the sealable fastener 10 further including a shank second end 26 terminating in a fastener second end wall 28, a shank side wall 32 extending between fastener head 60 and fastener second end 26, a continuous, fully circumferential channel 40 recessed into shank side wall 32, and including a sealant delivery passageway 50 having a passageway entry port 52 in the fastener head 60 and extending both longitudinally and laterally to a passageway exit port 54 opening into circumferential

channel 40.

The sealant delivery passageway 50 may be a bore in fastener shank 20 extending from entry port 52 substantially coaxially with or substantially parallel to the shank longitudinal axis L opening through exit port 54 into circumferential channel 40 or optionally opening through two separate exit ports 54 into first and second circumferential channels 140 and 142, respectively. In the latter instance, passageway 50 preferably includes passageway axial and radial segments 56 and 58, respectively, as illustrated. Exampl s are shown in FIGURES 1-4 in the form of boat hull screws or concrete anchor bolts. Alternatively, a first sealant delivery passageway segment 50a is provided including a fastener head bore extending from entry port 52 through the fastener head 60 opening through exit port 54 into a single circumferential channel 40 or into a first circumferential channel 140 and including a second sealant delivery passageway segment 50b in the form of a groove in the shank side wall 32 extending from first circumferential channel 140 substantially parallel to the shank longitudinal axis SL, and opening into second circumferential 142. Examples are shown in FIGURES 5-10 in the form of boat hull screws. The first sealant delivery passageway 50a alternatively is a notch in the side of the fastener head 60 extending from fastener first end wall 24 to circumferential channel 40 or to first circumferential channel 140. See FIGURE 11. The fastener head bore 50a preferably opens at the passageway entry port 52 at or near the center of fastener head 60 and angles outwardly from the shank longitudinal axis L as bore 50a

advances toward shank second end 26 to open into a circumferential channel 40 or a first circumferential channel 140 immediately below the fastener head 60. See FIGURE 10. Alternatively first sealant delivery passageway segment 50a is positioned off-center from and substantially parallel to shank longitudinal axis SL. See FIGURES 6 and 8. Still alternatively, the first sealant delivery passageway 50a is a bore extending through and beyond fastener head 60 into the fastener shank 20.

When fastener 10 is to be used, the fastener shank 20 is inserted into a fastener opening with a fastener opening longitudinal axis OL such as a fastener bore B in a receiving structure R such as a boat hull or a nut N. Then a flowable sealant S is injected into entry port 52 so that the sealant S flows through sealant delivery passageway 50 and exits through exit port 54 *and flows into and around circumferential channel* 40, creating a circumferential seal between fastener shank 20 and the receiving structure R so that water or other liquid cannot flow around the fastener shank 20 and through the receiving structure R. Sealant S injection is preferably preformed by an adhesive dispensing gun G, structured much like a conventional caulking gun, examples of which are found in the existing art.

Entry port 52 preferably opens into the fastener first end wall 24 and the passageway 50 preferably includes a passageway axial segment 56 extending directly toward the fastener second end wall 28 to a point between fastener first end wall 24 and second end wall 28, and a passageway radial segment 58 which extends from

passageway axial segment 56 to exit port 54, once again opening into circumferential channel 40. As indicated above, the shank first end 22 is distinct from but integrally joined to fastener head 60, the top of which is the fastener first end wall 24, and the passageway entry port 52 preferably opens into the fastener head 60. Circumferential channel 40 preferably is located either immediately adjacent to the fastener head 60 or midway between the shank first and second end walls 24 and 28, respectively, but can be located at virtually any point along shank 20 accessible by passageway 50. Fastener head 60 optionally forms a side of circumferential channel 40 or of first circumferential channel 140, as illustrated. Various channel 40 widths and depths may be provided, depending upon the type of sealant S used and upon the durability of sealing required for the specific application. Circumferential channel 40 is preferably deeper than any fastener threads 12 on the shank 20. Channel 40 optionally follows an irregular or skewed path around the shank 20. Several circumferentially spaced apart exit ports 54 optionally open into the circumferential channel 40 for more rapid and even distribution of sealant S into channel 40. See FIGURES 21-21b. The entry port 52 leading into sealant delivery passageway 50 or into first sealant delivery passageway segment 50 preferably is wider than the passageway 50 or passageway segment 50a at the shank first end 22 outer surface and narrows to the diameter of the passageway 50 or passageway segment 50a as it advances into shank first end 22, so that a sealant injection tool such as an adhesive dispensing gun G

can more easily inject sealant or adhesive into the entry port 52. Sealant delivery passageway 50 or passageway segment 50a alternatively is countersunk with a wider bore at entry port 52 as shown in FIGURE 8 to snugly receive a tip of a nozzle of a sealant or adhesive dispensing gun G, to constrain the sealant S to flow into sealant delivery passageway 50 to resist sealant S leakage.

Examples of flowable sealants are, but are not limited to, FUSOR SELF-LEVELING SEAM SEALER™, company reference number 122EZ, and LORD™ Urethane Adhesive, company reference numbers 7542A/B and 7545A/B. Fastener 10 is preferably configured as a bolt, but also may be configured as a screw, a pin, or a nail or a rivet (see FIGURE 22). While virtually all existing fasteners are circular in cross-section, this sealant S delivery feature is understood to be suited for incorporation into fasteners of other cross-sectional shapes, and thus the term "fastener" is understood to include fasteners of all cross-sectional shapes.

As mentioned above, several circumferential channels are optionally provided on a given fastener 10. A double chann l embodiment includes a first circumferential channel 140 located substantially one third of the shank 20 length from the fastener first end wall 24 and a second circumferential channel 142 located substantially two thirds of the shank 20 length from the fastener first end wall 24. See FIGURES 14 and 15. It is preferred that the second passageway radial segment 58 be wider than first passageway radial segment 58 and that second circumferential channel 142 be wider than first circumferential channel 140.

A triple channel embodiment includes a first circumferential channel 140 substantially at the shank 20 midpoint between fastener first end wall 24 and fastener second end wall 28, a second circumferential channel 142 substantially midway between fastener first end wall 24 and first circumferential channel 140 and a third circumferential channel 144 substantially midway between the fastener second end wall 28 and first circumferential channel 140. See FIGURES 16 and 17. Still more circumferential channels may be provided as desired for a given application. Once again, it is preferred that the second passageway radial segment 58 be wider than the first passageway radial segment 58 and that the second circumferential channel 142 be wider than first circumferential channel 140, and it is further preferred that the third passageway radial segment be wider than the first passageway radial segment 58 and that third circumferential channel 144 be wider than second circumferential channel 142. The reason for these distally progressive increments in passageway radial segment 58 diameters is that sealant S pressure diminishes as it flows distally, and a wider passageway radial segment 58 helps compensate for this loss in sealant S pressure.

As mentioned above, and illustrated in FIGURES 1-7a, generally, another embodiment has an open end channel 240 which extends from exit port 54 either to the fastener head 60 or to the shank second end 26. See additional examples in FIGURES 18 and 19. The depth of open end channel 240 is either equal to and preferably greater than the depth of the troughs of threads 12.

A seal confirmation passageway 70 is preferably provided for indicating when the circumferential channel 40 is filled with sealant S and forms a circumferential seal around the bolt shank 20. A seal confirmation passageway entry port 72 opens out of circumferential channel 40 into seal confirmation passageway 70 which extends generally axially through shank 20 to a seal confirmation passageway exit port 74 in shank first end 22. Seal confirmation passageway entry port 72 preferably opens out of circumferential channel 40 opposite passageway radial segment 58 so that sealant S only enters passageway 70 after flowing all the way around circumferential channel 40 and creating a complete seal. Where multiple circumferential channels 140, 142 and 144 are provided, seal confirmation passageway entry port 72 opens out of the most distal channel 144, which is preferably a deeper channel than channels 140 and 142 so that seal confirmation passageway 70 can extend substantially parallel to the shank longitudinal axis L and yet not intersect or enter channels 140 and 142. See FIGURE 23. Since sealant S reaches circumferential channel 140 first, reaches circumferential channel 142 second and only then reaches circumferential channel 144 third, the discharge of sealant S through passageway 70 indicating that third circumferential channel 144 is filled also indicates that sealant S has filled circumferential channels 140 and 142 as well. It is noted that a seal confirmation passageway 70 may be provided for any of the fasteners 10 illustrated in the attached FIGURES.

Method

In practicing the invention, the following method may be used. A method of securing the sealable fastener 10 into a fastener receiving structure R is provided including the steps of: inserting the shank second end 26 into the fastener opening or bore B so that the fastener shank longitudinal axis L is substantially parallel with the fastener opening longitudinal axis OL; rotating the fastener 10 so that the fastener shank 20 advances into the fastener opening or bore B until the fastener head 60 abuts the fastener receiving structure R; injecting a flowable sealant S into the delivery passageway entry port 52; and driving the sealant S through the sealant delivery passageway 50 and through the delivery passageway exit port 54 and into and around the circumferential channel 40 and into circumferential sealing contact with a fastener opening or bore interior surface OI or a portion thereof which is substantially parallel with the fastener opening longitudinal axis OL. See FIGURE 6a.

While the invention has been described, disclosed, illustrated and shown in various terms or certain embodiments or modifications which it has assumed in practice, the scope of the invention is not intended to be, nor should it be deemed to be, limited thereby and such other modifications or embodiments as may be suggested by the teachings herein are particularly reserved especially as they fall within the breadth and scope of the claims here appended.